UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/931,862	08/20/2001	Hae-Kyoung Kim	249/274	3541

7590 09/08/2005

LEE & STERBA, P.C.
1101 Wilson Boulevard
Suite 2000
Arlington, VA 22209

EXAMINER	
DOVE, TRACY MAE	
ART UNIT	PAPER NUMBER
1745	

DATE MAILED: 09/08/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/931,862	KIM, HAE-KYOUNG	
	Examiner	Art Unit	
	Tracy Dove	1745	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *12 July 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-3,5-12,14-24 and 26* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-3,5-12,14-24 and 26* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

This Office Action is in response to the communication filed on 7/12/05. Applicant's arguments have been considered, but are not persuasive. Claims 1-3, 5-12, 14-24 and 26 are pending. Claims 4, 13 and 25 have been canceled.

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 7/12/05 has been entered.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1-3, 5-12, 14-24 and 26 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claims 1, 10, 19 and 23 have been amended to recite the porous support is formed by first combining a polymer and a reinforcing agent to form a mixture and then molding the mixture. After molding, the ion-exchange polymer is impregnated into the molded porous support. This claim limitation is not supported by the specification as filed. The specification

clearly teaches the reinforcing agent and the ion-exchange polymer are impregnated into a porous support. Thus the porous support is already formed before the reinforcing agent and the ion-exchange polymer are impregnated into the porous support. See page 5, line 17-page 6, line 3; page 8, lines 4-7; page 10, lines 10-17; page 11, lines 14-22 and Example 1. Applicant has not pointed out the section of the specification that supports the added claim limitation.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 2, 5-11 and 14-24 and 26 are rejected under 35 U.S.C. 102(b)/103(a) as being anticipated by, and alternatively unpatentable over, Grot et al., US 5,919,583.

Regarding claims 1, 2, 6, 7, 10, 11, 15, 16, 19 and 21, Grot teaches a cation exchange membrane made from a polymer having cation exchange groups and containing inorganic filler. The membrane exhibits reduced fuel crossover for fuel cells employing direct feed organic fuels such as methanol (see abstract). Preferably the inorganic filler is an inorganic proton conductor selected from the group consisting of titanium dioxide, tin and hydrogen mordenite, oxides and

phosphates of zirconium, and mixtures thereof. The inorganic proton conductor comprises 2-30 wt% of the membrane (col. 2, lines 25-38). The membrane may optionally include a porous support for improving mechanical properties. The porous support may be a polyolefin (polyethylene or polypropylene) or polytetrafluoroethylene (PTFE) having at least 40% porosity (col. 5, lines 1-31). A membrane can be made using a porous support by coating cation exchange polymer on the support so that the coating is on the outside surfaces as well as being distributed through the internal pores (impregnates) of the support (col. 5, lines 32-33). The inorganic filler is dispersed in the membrane (impregnates) and may further be a zeolite material (col. 5, lines 58-63). Note titanium dioxide, zirconium oxide, mordenite and zeolite are moisture retentive materials, as described in the instant specification (page 9, lines 9-21).

Regarding claims 5, 8, 14, 17, 20 and 22, the cation exchange groups of the polymer are selected from the group consisting of sulfonate, carboxylate, phosphonate, imide, sulfonimide and sulfonamide. In a preferred embodiment, highly fluorinated polymer with sulfonate groups is employed (col. 2, lines 39-50). The term "sulfonate groups" is intended to refer either to sulfonic acid groups or alkali metal or ammonium salts of sulfonic acid groups (col. 3, lines 57-60). Example 2 teaches a solution containing a sulfonated perfluorocarbon copolymer having as a perfluorocarbon backbone and side chains $-O-CF_2CF(CF_3)-O-CF_2CF_2SO_3H$ in hydrogen ion form and which has an equivalent weight of about 1080. Tin mordenite is added to the solution and the solution is poured onto a polytetrafluoroethylene sheet substrate (porous support).

Regarding claims 9, 18, 23 and 26, a solution of an inorganic filler and a polymer ionic form can be used to apply a coating to a porous support to form the membrane (col. 6, lines 42-46). The polymer is distributed through the internal pores of the support (col. 5, lines 32-35) and

the inorganic filler is incorporated into the membrane (col. 6, line 40). Thus, the membrane of Grot is formed by impregnating the porous support with a composition of ion-exchange polymer and the inorganic filler (reinforcing agent).

Thus the claims are anticipated. The claims are alternatively unpatentable because the courts have ruled that product-by-process limitations, in the absence of unexpected results are obvious. Furthermore, claims 23 and 26 have been rejected as containing new matter.

*

Claims 1-3, 6-12, 15-24 and 26 are rejected under 35 U.S.C. 102(b) as being anticipated by Bahar et al., US 5,635,041 and/or under 35 U.S.C. 103(a) as unpatentable over, Bahar et al., US 5,635,041.

Bahar teaches a composite membrane comprising a base material 4 and an ion exchange material/resin 2. The base material is a porous microstructure (porous support) and the ion exchange resin impregnates the membrane, i.e. base material (col. 3, lines 29-40). The ion exchange material may be comprised of at least in part a powder, such as but not limited to, carbon black, graphite, nickel, silica, titanium dioxide and platinum black (col. 2, lines 58-61). Optionally, the ion exchange materials may be complemented by finely divided powders or other (non-ionic) polymers to provide final composites. Such a finely divided powder may be selected from organic or inorganic compounds such as, but not limited to, carbon black, graphite, nickel, silica (SiO_2), titanium dioxide (TiO_2) or platinum black (catalyst). The powders provide specific added effects such as electrical conductivity, thermal conductivity, catalytic effects and/or enhanced or reduced reactant transport properties (col. 4, line 66-col. 5, line 8). Note silica and

titanium dioxide are moisture retentive materials and platinum is a catalyst, as described in the instant specification (page 9, lines 9-21).

Regarding claims 6-7, a preferred base material is expanded polytetrafluoroethylene (ePTFE) having a porosity of greater than 35%, preferably between 70-95% (col. 3, lines 62-67).

Regarding claim 8, suitable ion exchange materials include perfluorinated sulfonic acid resin, perfluorinated carboxylic acid resin, polyvinyl alcohol, divinyl benzene, styrene-based polymers and metal salts with or without a polymer (col. 4, lines 58-63).

Regarding claims 9 and 23, a solution is prepared containing an ion exchange material (and optionally a finely divided powder). The solution may be applied to the base material by any conventional coating technique including roll coating, gravure coating, doctor coating, kiss coating, dipping, brushing, painting or spraying so long as the liquid solution is able to penetrate the interstices and interior volume of the base material (col. 6, lines 19-27).

Regarding claims 10-12 and 15-18, the composite membrane may be used in a fuel cell (claim 4). Ion exchange membranes are used in polymer electrolyte fuel cells as solid electrolytes (col. 1, lines 14-15). The composite membrane of Bahar may be used in various applications, including fuel cells and batteries (col. 3, lines 41-44).

Regarding claims 19-22, a direct methanol fuel cell (DMFC) has the same structure as the polymer electrolyte membrane fuel cell (PEMFC), but uses liquid methanol, instead of hydrogen, as a fuel source (see page 3, lines 13-14 of the instant specification "Description of Related Art). Thus, the direct methanol fuel cell of claim 19 is a polymer electrolyte fuel cell (taught by Bahar). Note that whether methanol or hydrogen is used as the fuel source, the fuel cell is a

polymer electrolyte type fuel cell (the terminology of the preamble does not limit the claimed structure MPEP 2111.02).

Thus the claims are anticipated. The claims are alternatively unpatentable because the courts have ruled that product-by-process limitations, in the absence of unexpected results are obvious. Furthermore, claims 23 and 26 have been rejected as containing new matter.

*

Claims 1-3, 5-12, 14-24 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Watanabe et al., US 5,766,787 in view of Grot et al., US 5,919,583.

Watanabe teaches a solid polymer electrolyte fuel cell comprising a solid polymer electrolyte membrane incorporating 5.8 wt% platinum catalyst and 5 wt% silica in Nafion (perfluorocarbon sulfonic acid cation exchange resin) or 5.8 wt% platinum catalyst and 5 wt% titania (TiO_2) in Nafion. See col. 6, lines 40-48 and col. 8, lines 23-64. Thus, the platinum catalyst is about 54 wt% and the silica (or titania) is about 46 wt% of the total amount of catalyst plus metal oxide (reinforcing agent) contained in the polymer electrolyte membrane. The membrane comprises 0.01-80 wt% of at least one metal catalyst (Pt, Au, Pd, Rh, Ir and/or Ru) and 0.01-50wt% of particles and/or fibers of at least one metal oxide (silica, titania and/or zirconia). See col. 3, lines 29-42. Methanol gas and oxygen gas may be used as the reactant gases for the fuel cell (col. 3, lines 57-59). Watanabe teaches the membrane possesses the abilities of producing water by itself and of retaining the water so that the ionic conductivity and the effect of depressing the crossover is excellent (abstract).

Watanabe does not explicitly state the polymer electrolyte membrane includes a porous support.

However, Grot teaches a cation exchange membrane made from a polymer having cation exchange groups and containing inorganic filler. The membrane exhibits reduced fuel crossover for fuel cells employing direct feed organic fuels such as methanol (see abstract). Preferably the inorganic filler is an inorganic proton conductor selected from the group consisting of titanium dioxide, tin and hydrogen mordenite, oxides and phosphates of zirconium, and mixtures thereof. The inorganic proton conductor comprises 2-30 wt% of the membrane (col. 2, lines 25-38). The membrane may optionally include a porous support for improving mechanical properties, for decreasing cost and/or other reasons. The porous support may be a polyolefin (polyethylene or polypropylene) or polytetrafluoroethylene (PTFE) having at least 40% porosity (col. 5, lines 1-31). A membrane can be made using a porous support by coating cation exchange polymer on the support so that the coating is on the outside surfaces as well as being distributed through the internal pores (impregnates) of the support (col. 5, lines 32-33). The inorganic filler is dispersed in the membrane (impregnates) and may further be a zeolite material (col. 5, lines 58-63). Note titanium dioxide, zirconium oxide, mordenite and zeolite are moisture retentive materials, as described in the instant specification (page 9, lines 9-21).

Grot further teaches the cation exchange groups of the polymer are selected from the group consisting of sulfonate, carboxylate, phosphonate, imide, sulfonimide and sulfonamide. In a preferred embodiment, highly fluorinated polymer with sulfonate groups is employed (col. 2, lines 39-50). The term "sulfonate groups" is intended to refer either to sulfonic acid groups or alkali metal or ammonium salts of sulfonic acid groups (col. 3, lines 57-60). Example 2 teaches a solution containing a sulfonated perfluorocarbon copolymer having as a perfluorocarbon backbone and side chains $-O-CF_2CF(CF_3)-O-CF_2CF_2SO_3H$ in hydrogen ion form and which has

an equivalent weight of about 1080. Tin mordenite is added to the solution and the solution is poured onto a polytetrafluoroethylene sheet substrate (porous support).

Therefore, the invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made because one of skill would have been motivated to incorporate a porous support in the polymer electrolyte membrane of Watanabe in order to improve the mechanical properties and/or decrease the cost of the membrane (see Grot col. 5, lines 1-3). Grot teaches that the polymer electrolyte membranes optionally include a porous support. Therefore, one of skill in the art would be motivated to provide a porous support in the polymer electrolyte membrane of Watanabe in order to improve the mechanical properties of the membrane and/or to decrease the cost of the membrane. Grot teaches membranes containing a cation exchange polymer and a reinforcing agent (as defined by the instant specification) may or may not include a porous support. Both Watanabe and Grot teach direct methanol fuel cells.

Regarding the process limitations of claims 1, 10, and 19, the courts have ruled product-by-process limitations, in the absence of unexpected results, are obvious. See MPEP 2113. Regarding claims 9 and 18, "formed by impregnating or spray-coating the porous support with a slurry of the ion-exchange polymer and additional reinforcing agent" is a product-by-process limitation. The courts have ruled product-by-process limitations, in the absence of unexpected results, are obvious. See MPEP 2113. Furthermore, these limitations have been rejected as new matter.

Response to Arguments

Applicant's arguments filed 7/12/05 have been fully considered but they are not persuasive.

Applicant submits the combination of the Watanabe and Grot references fails to disclose or suggest the *porous support is formed by* combining a polymer and the reinforcing agent to form a mixture, then molding the mixture, after which the ion-exchange polymer is applied to the porous support. However, this a product-by-process limitation that is not given patentable weight in the absence of unexpected results. Furthermore, the claim limitations is rejected as containing new matter. If the new matter rejection is overcome, Examiner will consider this argument regarding claims 23 and 26 (method claims).

Applicant submits the Bahar reference fails to disclose or suggest the *porous support is formed by* combining a polymer and the reinforcing agent to form a mixture, then molding the mixture, after which the ion-exchange polymer is applied to the porous support. However, this a product-by-process limitation that is not given patentable weight in the absence of unexpected results. Furthermore, the claim limitations is rejected as containing new matter. If the new matter rejection is overcome, Examiner will consider this argument regarding claims 23 and 26 (method claims).

Applicant alleges unexpected results. However, unexpected results must distinguish the claimed invention over the prior art of record. An example showing unexpected results between a membrane fabricated with the reinforcing agent and a membrane fabricated without the reinforcing agent does not distinguish over the cited prior art because the cited prior art teaches a membrane fabricated with a reinforcing agent.

The declaration under 37 CFR 1.132 filed 2/3/05 is insufficient to overcome the rejections set forth in this Office action because: the declaration is not commensurate in scope with the present invention. The declaration submits PVDF, SiO2, acetone and DBP were milled

using a ball-mill process and then cast to obtain a membrane. The DBP was removed to form a porous membrane. A mixture of Nafion 115 and ethanol were coated on the porous membrane and then dried. However, this embodiment contained in the declaration is not supported by the present specification. Examples 1-8 of the present specification disclose a PTFE microporous membrane was soaked in, or spray-coated with, a slurry comprising Nafion, silica and ethanol, then dried. None of the Examples of the present specification are commensurate in scope with the embodiment of the declaration.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tracy Dove whose telephone number is 571-272-1285. The examiner can normally be reached on Monday-Thursday (9:00-7:30).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Pat Ryan can be reached on 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

September 2, 2005

TRACY DOVE
PRIMARY EXAMINER